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Using ionization injection to get high quality electron beam in laser wakefield acceleration

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Ionization injection can be used to get high quality electron beam in laser wakefield acceleration. To get low energy spread, two injection schemes are proposed here. By use of certain initially unmatched laser pulses, the electron injection can be constrained to the very front region of the mixed gas target, typically in a length of a few hundreds micro meters determined by laser-driven bubble deformation, and energy spread is largely reduced [1]. By using this method, electron beam with FWHM energy spread less than 5% and peak energy around 500MeV is demonstrated by multi-dimensional particle in cell (PIC) simulations We will show some recent experimental demonstration of this scheme at Laboratory for Laser Plasmas at Shanghai Jiao Tong University. In a second scheme, we suggest to use two color beat wave to control the injection length [2]. When two laser pulses with fundamental frequency and high harmonics co-propagate with each other, a beat wave is generated and the highest electric field due to the overlapping of the two peaks of the two laser waves can ionize the internal electrons and trigger the ionization injection.

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